

1.0 EXECUTIVE SUMMARY

1.1 Hindustan Petroleum Corporation Ltd. operates an 8.33 MMTPA refinery at Vishakhapatnam in the state of Andhra Pradesh.

The Visakh Refinery of HPCL is one of the most integrated refineries with three crude distillation units, MS Block (NHT-ISOM-CCR), Diesel Hydro Desulphurization unit, two Fluid Catalytic Cracking units, Diesel hydro treating unit, , Visbreaker Unit, Bitumen Blowing unit and Propylene Recovery unit. Currently the Refinery is implementing the DHT Project under which a Diesel Hydrotreater unit of 2.2 MMTPA is being installed.

1. 2 HPCL now intends to further enhance its refining capacity up to 15 MMTPA under VRMP (Visakh Refinery Modernization Project).

1.3 In order to arrive at the most economically viable and operationally flexible option for attaining long term profitability and global competitiveness, Visakh Refinery is also presently looking at options for upgrading the vacuum residue. The selected bottoms upgrading technology is Solvent Deasphalting Unit with a downstream Slurry Hydrocracker Unit.

1. 4 Engineers India Limited has been entrusted to prepare a Detailed Feasibility Report for 15 MMTPA Visakh Refinery Modernization Project for HPCL. The major objectives of the configuration study are:

- Maximization of Diesel.
- Excess Naphtha after meeting MS demand shall be considered for merchant sale.
- Motor spirit & Diesel to conform to Euro V specifications, both Euro IV and Euro V products will be manufactured. Euro V production shall be maximized after ensuring total capacity utilization of existing treatment facilities.
- Slurry Pitch and asphalt shall be considered as a product for merchant sale.

- Fuel oil production for sales to be minimized

1. 5 Design Basis

Major features of the design basis are as follows:

1.5.1 The following crude cases have been considered for the study:

- **Design Crude:** 55% Arab Heavy +5% Doba +20% Kuwait Export + 20% Bonny Light
- **Check Crude:** The following check cases are considered:
 - a) 70% Arab Heavy + 30% Maya
 - b) 60% Kuwait + 40% Bonny Light / 100% Arab medium

Configuration study is developed based on Design case Crude mix. The check case crude mixes are considered to identify constraints in unit capacities.

1.5.2 Refining capacity: The study is carried out for 15 MMTPA throughputs based on 8000 stream hours per year.

A new CDU of 9.0 MMTPA will be considered in lieu of one of the existing CDU. Therefore the new configuration shall be based on two CDUs:

- New CDU : 9.0 MMTPA
- Existing CDUs : 6.0 MMTPA

The new CDU IV shall be designed for 92% AH and 8% Doba. Out of the two existing CDUs, one shall process 3.0 MMTPA of 100% Kuwait export and the other shall process 3.0 MMTPA of 100% Bonny light.

1.5.3 Processing options: Combinations of following processing scenarios have been considered for the configuration:

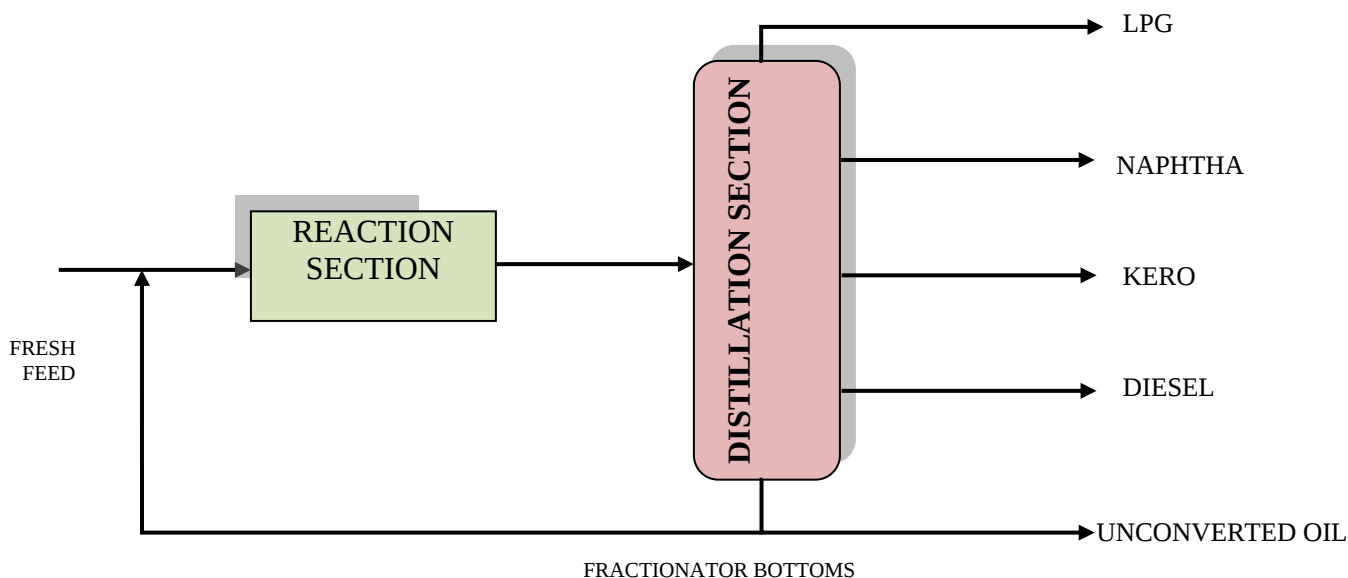
a) Secondary processing:

For Secondary Processing following options were considered:

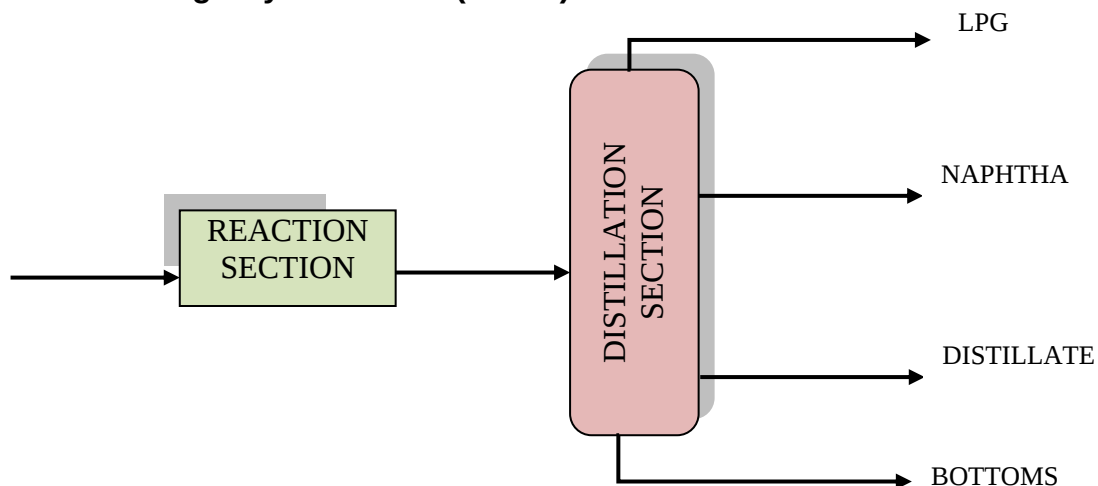
- Full conversion hydrocracker
- Once Through hydrocracker
- VGO Hydrotreater + Petro FCC

Full Conversion Hydrocracker:

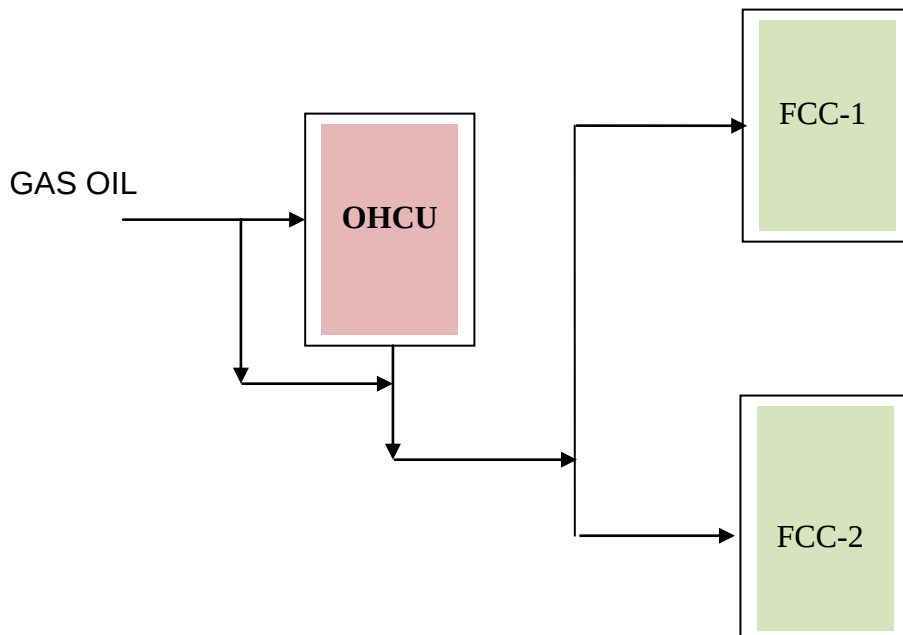
Full conversion Hydrocracker has been configured in the VRMP model, to only process the excess gas oil after saturating the existing FCCs. The bottom product from HCU is very small and this is routed to IFO pool. In order to maximize the production of middle distillates, the severity and recycle is set to maximize diesel from HCU instead of naphtha.



Once Through Hydrocracker (OHCU)



For VRMP, OHCU has been considered upstream of existing FCCs i.e. all the sour gas oil is processed in OHCU and the FCC feed comprises of OHCU bottoms plus sweet VGO wherever applicable. This is shown below:



The single stage scheme is adapted for conversion of vacuum gas oils into middle distillate and allows for High selectivity.

VGO HDT + FCC-PC

VGO HDT unit prepares the feed for FCC PC unit. Straight run vacuum gas oils, Slurry hydrocracker gas oils and Deasphalted oil are routed as feed streams to this unit. The severity of the VGOHDT unit is set to achieve the desired H₂ content as well as maximizing the FCC-PC feed.

VGO HDT bottoms are considered as main feed stock for FCC-PC unit. The FCC process can enable refiners to convert the VGO HDT bottoms into high octane gasoline, olefin rich light gases (such as propylene) and light fuel oils. The severity of FCCPC for propylene production can vary from 12 to 20wt%.

For VRMP, VGO hydro-treater has been considered only for the new FCC with existing FCCs continuing to process sour VGO.

b) Residue Upgradation

In the existing Refinery, there is a 1.0 MMTPA Visbreaker unit and a 0.225 MMTPA Bitumen Blowing Unit. The processing capacity of the existing Residue Upgradation units does not match with the crude processing capacity. Therefore under VRMP it is proposed that the Residue Upgradation units shall process the entire Vacuum residue for the 15.0 MMTPA refinery.

It is proposed that a new Solvent Deasphalting unit of 2.55 MMTPA shall be installed which shall process the balance vacuum residue after saturating the existing VBU and BBU. The pitch from SDA unit along with FCC clarified oil and Visbreaker Tar shall be fed to the new Slurry Hydrocracking unit.

Different combinations of SDA and SHCU have been considered which are as follows:

- Solvent Deasphalting (SDA) Unit followed by Slurry Hydrocracking Unit (SHCU) without product treatment

- Solvent Deasphalting (SDA) Unit followed by Slurry Hydrocracking Unit (SHCU) with product treatment
- Solvent Deasphalting (SDA) Unit followed by Slurry Hydrocracking Unit (SHCU) with product treatment and external processing of VGO.

Delayed coker technology has not been considered as an option for residue up-gradation due to plot area constraints and coke disposal issue. Also, Delayed coker technology has lower conversion as compared to other contemporary technologies.

- c) New alkylation units, new Hydrogen generation unit, Sulphur block (SRU+SWS+ARU) and other process and treating facilities as required have been considered for configuration analysis. Revamp of the existing process units has been considered in the present report like Naphtha Isomerisation unit, Continuous Catalytic Reformer (CCR), Diesel Hydrodesulphurization Unit (DHDS), Diesel Hydrotreater Unit (DHDT) as mentioned in the specified cases.
- d) All the possible options for the configuration study have been analyzed for two cases again :
- Naphtha as feed for HGU and CPP
 - Natural Gas as feed for HGU and CPP
- e) Product quality: The product quality for MS and HSD considered in the study corresponds to Euro-IV and Euro-V specifications.

Table-1.1: MS Product Quality

Gasoline		Euro V	
Specific gravity	min	wtppm	0.72
	max		0.775
Sulfur, max			10
RON, min			95
MON, min			85
Reid vapor pressure, max		kPa	60
Recovery at 70 °C	min	vol%	10
	max	vol%	45
Recovery at 100 °C			

	min	vol%	40
	max	vol%	70
Recovery at 150 °C, min		vol%	75
FBP, max		°C	210
Aromatics, max		vol%	30
Benzene, max		vol%	1
Olefins, max		vol%	14
VL summer/winter (10RVP+7E70), MAX			750/950
Oxygen content, max		wt%	2.7
Oxygenates content, max			
Methanol		vol%	3
Ethanol		vol%	5
Iso-propyl alcohol		vol%	10
Iso-butyl alcohol		vol%	10
Tertiary-butyl alcohol		vol%	7
Ethers with 5 or more carbon atoms		vol%	15
Other oxygenates		vol%	8
Regular Gasoline			(Euro – IV)
Specific gravity			
	min		0.72
	max		0.775
Sulfur, max		wtppm	50
RON, min			91
MON, min			81
Reid vapor pressure, max		kPa	60
Recovery at 70 °C			
	min	vol%	10
	max	vol%	45
Recovery at 100 °C			
	min	vol%	40
	max	vol%	70
Recovery at 150 °C, min		vol%	75
FBP, max		°C	210
Aromatics, max		vol%	35
Benzene, max		vol%	1
Olefins, max		vol%	21
Oxygen content, max		wt%	2.7
Oxygenates content, max			
Methanol		vol%	3
Ethanol		vol%	5
Iso-propyl alcohol		vol%	10
Iso-butyl alcohol		vol%	10
Tertiary-butyl alcohol		vol%	7
Ethers with 5 or more carbon atoms		vol%	15
Other oxygenates		vol%	8
Premium Gasoline			(Euro – IV)
Specific gravity			
	min		0.72
	max		0.775
Sulfur, max		wtppm	50
RON, min			95
MON, min			85
Reid vapor pressure, max		kPa	60
Recovery at 70 °C			
	min	vol%	10
	max	vol%	45
Recovery at 100 °C			

	min	vol%	40
	max	vol%	70
Recovery at 150 °C, min		vol%	75
FBP, max		°C	210
Aromatics, max		vol%	35
Benzene, max		vol%	1
Olefins, max		vol%	21
Oxygen content, max		wt%	2.7
Oxygenates content, max			
Methanol		vol%	3
Ethanol		vol%	5
Iso-propyl alcohol		vol%	10
Iso-butyl alcohol		vol%	10
Tertiary-butyl alcohol		vol%	7
Ethers with 5 or more carbon atoms		vol%	15
Other oxygenates		vol%	8

Table-1.2: Diesel Product Quality

<u>Diesel</u>			(Euro – IV)
Specific gravity	min		0.82
	max		0.845
Sulfur, max		Wtppm	50
Viscosity at 40 °C	min	cSt	2
	max	cSt	4.5
95% recovery, max		°C	360
Flash point (Abel), min		°C	35
Cetane number, min			51
Cetane index, min			48
Poly aromatic hydrocarbon, max		wt%	11
Cold filter plugging point, max			
	Summer	°C	18
	Winter	°C	6
<u>Diesel (Export)</u>			Euro V
Specific gravity	min		0.82
	max		0.845
Sulfur, max		Wppm	10
Viscosity at 40 °C	min	cSt	2
	max	cSt	4.5
95% recovery, max		°C	360
Flash point (Abel), min		°C	66
Cetane number, min			51
Cetane index, min			48
Poly aromatic hydrocarbon, max		wt%	11
Cold filter plugging point, max			
	Summer	°C	18
	Winter	°C	6
<u>Diesel (Domestic)</u>			Euro V
Specific gravity	min		0.82
	max		0.845
Sulfur, max		Wppm	10

Viscosity at 40 °C	min	cSt	2
	max	cSt	4.5
95% recovery, max		°C	360
Flash point (Abel), min		°C	35
Cetane number, min			51
Cetane index, min			48
Poly aromatic hydrocarbon, max		wt%	11
Cold filter plugging point, max			
	Summer	°C	18
	Winter	°C	6

- f) Feed / product cost / price data considered in the study is as per the data provided by HPCL.

Table-1.3: Feed/Product Prices

	Units Of Measurement for Price	Price
Natural Gas	US\$/MMBTU	14
Crude		
Arab Heavy	US\$/bbl	78.66
Doba	US\$/bbl	73.55
Kuwait	US\$/bbl	80.16
Bonny Light	US\$/bbl	87.12
Products		
Propylene - zone	Rs./MT	41303
LPG - Zone	Rs./MT	31369
LPG – Out of Zone	Rs./MT	31369
Naphtha - Zone	Rs./MT	33897
Naphtha – Out of Zone	Rs./MT	33897
MS Euro IV Regular Zone	Rs./MT	37519
MS Euro IV Regular Out of Zone	Rs./MT	37519
MS Euro IV to MDPL	Rs./MT	37519
MS Euro V - Zone	Rs./MT	38118
MS Euro V - Out of Zone	Rs./MT	38118
MS Euro V - Export	Rs./MT	37143
Jet fuel - Zone	Rs./MT	33876
Jet fuel – Out of Zone	Rs./MT	33876
Kerosene - Zone	Rs./MT	34424

	Units Of Measurement for Price	Price
Kerosene – Out of Zone	Rs./MT	34424
Diesel Euro IV - Zone	Rs./MT	35643
Diesel Euro IV – Out of Zone	Rs./MT	35643
Diesel Euro IV – via Paradeep to Interior	Rs./MT	35643
Diesel Euro V - Zone	Rs./MT	35820
Diesel Euro V – Out of Zone	Rs./MT	35820
Diesel Euro V – to MDPL	Rs./MT	35820
LDO - Zone	Rs./MT	28939
LDO – Out of Zone	Rs./MT	28939
LSHS - Zone	Rs./MT	24136
LSHS – Out of Zone	Rs./MT	24136
Fuel Oil – Zone	Rs./MT	23189
Fuel oil- Out of Zone	Rs./MT	23189
Bitumen -Zone	Rs./MT	23583
Bitumen – Out of Zone	Rs./MT	23583
Sulphur	Rs./MT	5057

Table-1.4: Utility Prices

Sl.No	Utility	Units Of Measurement for Price	Average cost (for 3 years 2008- 09,2009-10,2010-11)
1	Raw Water	Rs/M3	30
2	DM Water	Rs/M3	50.2
3	Boiler Feed Water	Rs/m3	211.3
4	Bearing Cooling Water	Rs/m3 of water circulated	2.1
5	Sea cooling Water		
a	Once Thro'	Rs/m3	1.9
b	Recirculating	Rs/m3	2.7
6	Nitrogen	Rs/Nm3	7.0
7	Fuel Oil	Rs/MT	22911.7
8	Fuel Gas	Rs/MT	22635.4
9	Plant Air	Rs/Nm3	0.9
10	Instrument Air	Rs/Nm3	1.1
11	Steam		
	VHP Steam	Rs/MT	1879.8

Sl.No	Utility	Units Of Measurement for Price	Average cost (for 3 years 2008-09,2009-10,2010-11)
12	Electric power		
	Captive Power Plant	Rs/KWH	7.0

- g) The product demands have been defined by HPCL and relate to zone, out of zone and export markets.

Table-1.5 : Product Constraints

S NO.	Product	Minimum (000 TPA)	Maximum (000TPA)
1.	Propylene - zone	66	66
2.	LPG - Zone	0	3229
3.	LPG – Out of Zone	0	3229
4.	Naphtha - Zone	0	28
5.	Naphtha – Out of Zone	0	9
6.	MS Euro IV Regular Zone	0	774
7.	MS Euro IV Regular Out of Zone	0	375
8.	MS Euro IV to MDPL	0	771
9.	MS Euro V - Zone	0	202
10.	MS Euro V - Out of Zone	0	203
11.	MS Euro V - Export	0	875
12.	Jet fuel - Zone	29	29
13.	Jet fuel – Out of Zone	1.5	1.5
14.	Kerosene - Zone	448	463
15.	Kerosene – Out of Zone	0	230
16.	Diesel Euro IV - Zone	0	3898
17.	Diesel Euro IV – Out of Zone	0	2081
18.	Diesel Euro IV – via Paradeep to Interior	0	671
19.	Diesel Euro V - Zone	0	320
20.	Diesel Euro V – Out of Zone	0	624
21.	Diesel Euro V – to MDPL	0	1906
22.	LDO - Zone	0	3
23.	LDO – Out of Zone	0	31

S NO.	Product	Minimum (000 TPA)	Maximum (000TPA)
24.	LSHS - Zone	0	61
25.	LSHS – Out of Zone	0	261
26.	Fuel Oil – Zone	0	174
27.	Fuel oil- Out of Zone	0	982
28.	Bitumen -Zone	5	5
29.	Bitumen – Out of Zone	463	463
30.	Sulphur	0	28

1.6 Refinery Configuration Study

A number of configuration cases incorporating the various processing options outlined above have been evaluated under this study for screening purposes. A summary of the considerations is as follows:

- A new CDU/VDU of 9.0 MMTPA capacity has been considered with the phasing out of CDU/VDU-I in all the cases. The new CDU/VDU of 9.0 MMTPA capacity shall only processes 92% Arab Heavy + 8% Doba. The low sulphur crudes are preferably processed in CDU/VDU-II.
- For bottoms upgrading Solvent Deasphalting Unit (SDA) followed by a Slurry Hydro cracking Unit (SHCU) has been considered. The DAO from SDA unit is routed for further processing in the secondary processing units like FCC and Hydrocracker. The Pitch from SDA unit along with Visbreaker Tar and FCC CLO is routed to SHCU. Products from SHCU are routed as follows: SHCU Naphtha and Diesel to DHT and SHCU VGO to HCU/ FCCU.
- Once through hydro-cracker (OHCU) has been considered upstream of existing FCCs i.e. all the sour VGO is processed in OHCU and the FCC feed comprises of bottoms from the OHCU.

- d. In case of full-conversion hydro-cracker, the hydro-cracker only processes the excess VGO after saturating the existing FCCs. The small bottom product from HCU is routed to IFO pool.
- e. For VGO-HDT option, the existing FCCs continue to process untreated VGO.
- f. The requirements of various products have been defined on the basis of market i.e. Zone, Out of Zone and Export. The products make constraints remain constant for various refining throughputs and have accordingly been incorporated in the model with respective prices.

In case of Natural gas firing and natural gas as feed to CPP and HGU, excess Naphtha is exported.

Configuration Cases Evaluated

A number of configuration cases have been evaluated. These cover the cases as desired by HPCL as well as additional configurations evolved during the study which is discussed in section 5.0 of the report. The salient features of the study are as follows:

Light End processing

- ☐ Euro V gasoline requires Alkylation Unit
- ☐ Revamp of CCR and ISOM is required to meet the gasoline requirements.
- ☐ NHT revamp comes up only when natural gas is used for firing in CPP and HGU.

Secondary processing

- ☐ Full Conv HCU gives high GRM and produces maximum diesel.

- ☐ Once through Hydrocracker (55% conv) is also short listed as it can provide hydrotreated feed to FCCs and does not require the operation of the FGDs.
- ☐ FCC-PC case is not favorable as it does not meet the refinery objective of diesel maximization and has low GRM too.

Resid Upgradation

- ☐ Slurry hydrocracker clubbed with product hydrotreater is the preferred option.
- ☐ Revamp of DHDS and DHDT comes up only when SHCU is not clubbed with the product hydrotreater.
- ☐ Delayed coker technology has not been considered as an option for residue up-gradation due to plot area constraints and coke disposal issue. Also, Delayed coker technology has lower conversion as compared to other contemporary technologies.

Natural Gas use

- ☐ The use of natural gas for firing in CPP & HGU is economically very lucrative for the refinery. However, the same is also dependent on the cost at which it is procured by HPCL.
- ☐ Natural gas firing also helps in lowering the refinery SO_x emission.
- ☐ However, the demand for excess naphtha, which is generated in natural gas cases, needs to be explored.
- ☐ Also, the availability of natural gas in future at the refinery gate is yet not firmed up. Therefore further studies shall be based on Naphtha firing.

Based on the above analysis, following cases have been shortlisted jointly by HPCL and EIL for capital cost estimation and financial analysis.

1. Case 1A (Full Conv HCU + Slurry HCU + naphtha firing)
2. Case 1B (Once Through HCU + Slurry HCU + naphtha firing)
3. Case 2A (Full Conv HCU + Slurry HCU clubbed with product hydrotreater + naphtha firing)

4. Case 2B (Once Through HCU + Slurry HCU clubbed with product hydrotreater + naphtha firing)

A comparison of the short listed cases Vis a Vis the existing refinery is as given below:

Table-1.6: Material balance for selected cases (KTPA)

	Base Case	Case - 1A (FC_HCU+SHCU +Naphtha firing)	Case - 1B (OHCU+SHCU +Naphtha firing)	Case - 2A (FC_HCU+SHCU clubbed with product hydrotreater +Naphtha firing)	Case - 2B (OHCU+SHCU clubbed with product hydrotreater +Naphtha firing)
Crude processed	8333	15000	15000	15000	15000
Chemical Grade Propylene	72	105	157	115	163
LPG	373.33	475	474	478	467
Naphtha	221.33	37	37	37	37
MS Euro III	816	0	0	0	0
MS Euro IV	595.67	1920	1920	1920	1920
MS Euro V	0	287	918	303	697
JET FUEL	1.33	31	31	31	31
Kerosene	539.67	693	693	693	693
Diesel - IV	2297.67	6650	6032	6650	6650
Diesel Euro V	0	1928	2095	2178	1814
Fuel Oil	2494.67	317	0	164	0
Bitumen	220.33	221	221	221	221
SDA Pitch	0	0	0	0	15
SHCU Pitch	0	260	256	169	165
Sulphur	58.67	264	285	235	259
Fuel & Losses	642	1812	1881	1806	1868
Refinery GRM (US\$/bbl)	6.55	11.581	11.615	12.795	12.426

1.6 Capital Cost estimate

Key Assumptions:

The basic assumptions made for working out the capital cost estimate are as under:

- Cost estimate is valid as of March 2012 price basis.
- No provision has been made for any future escalation
- No provision has been made for any exchange rate variation.
- It has been assumed that all units and utilities / off-sites facilities would be implemented on conventional mode.
- Process units cost estimates are based on reference technology. Any change in technology shall have impact on units' cost estimates.
- Soft soil has been considered for Earthwork in excavation including clearing & stripping.
- It has been assumed that infrastructure facilities is adequate
- EPCM services cost provision is as a factor basis of plant and machinery cost and is indicative.
- All costs are reflected in INR and all foreign costs have been converted into equivalent INR using exchange rate of 1USD=Rs 45.0.

Exclusions:

Following costs have been excluded from the Project cost estimate:

- Forward escalation
- Exchange rate variation
- Cost towards statutory clearances
- Railway siding
- Township
- Shutdown Works

Estimation Methodology:

As indicated above, the estimated project cost for the identified scope and technical details for the shortlisted cases works out to as under-

Table-1.7, Capital cost (Rs. Crores) of shortlisted cases

S.No.	Cases	Fc	Ic	Total Capital
1	FC_HCU + SHC + Naphtha Firing (Case 1A)	1259.52	13607.83	14903.304
2	OHCU + SHC + Naphtha Firing (Case 1B)	1307.47	14849.4	16156.87
3	FC_HCU + SHC Clubbed with product hydrotreater + Naphtha Firing (Case 2A)	1230.29	13823.36	15053.65
4	OHCU + SHC Clubbed with product hydrotreater + Naphtha Firing (Case 2B)	1237.43	14805.36	16042.79

Cost estimate is based on cost information available from EIL's current in-house cost data and Engineering inputs for cost estimation purpose. In-house cost data has been analyzed and adopted for estimation after incorporating specific project conditions. Cost data has been updated to prevailing price level using relevant economic indices.

1.7 Financial Analysis

Based on capital cost, operating cost and sales revenue, financial analysis have been carried out for calculating internal rate of return (IRR) with a view to establish profitability of the project.

Table-1.8: IRR of shortlisted cases

SI No.	Case	Case 1A	Case 1B	Case 2A	Case 2B
1	Capital Cost (Rs. Lakhs)	1490330	1615687	1505365	1604279
2	Variable Operating Cost (Rs. Lakhs/ year)	1713394	1713538	1713284	1711831
3	Fixed Operating Cost (Rs. Lakhs/ year)	24806	26901	25077	26795
4	Total Operating Cost (Rs. Lakhs/ year)	1738200	1740439	1738361	1738626
5	Sales Revenue (Rs. Lakhs/ year)	2113502	2139034	2171640	2171538
6	IRR (Pre Tax) on Total Capital (%)	17.45%	18.18%	20.17%	19.82%
7	IRR (Post Tax) on Total Capital (%)	13.9%	14.88%	16.16%	16.21%

1.8 Selection of Final Configuration

Based on the above analysis the configuration consisting of Full conversion Hydrocracker as secondary processing unit and a combination of Solvent Deasphalting Unit followed by Slurry Hydrocracker clubbed with product hydrotreater Unit as Residue Upgradation unit (Case-2A) is selected because:

- This configuration has the highest GRM
- High IRR

- Low Capital cost
- Less Plot area required
- Maximum Diesel production.
- A single high pressure hydrocracker unit is easy for operation than operating two high pressure hydrocracker units.
- Flexibility exists to convert the full conversion Hydrocracker unit to a higher capacity Once through Hydrocracker unit later. If the capital required for the conversion can be pre-invested now, then the shutdown time can be limited to a lower duration.

1.9 New Process Units in selected configuration

The capacities of various new process units for the selected case are listed below:

Table-1.9: New Unit Capacities

			CASE 2A
A.	Main Processing Unit		CAPACITY
1	CDU / VDU	MMTPA	9
2	ALKYLATION	KTPA	200
3	FULL CONVERSION HCU	MMTPA	2.8
4	SOLVENT DEASPHALTING	MMTPA	2.5
5	SLURRY HYDROCRACKER	MMTPA	2.8
6	PRU	TPD	128
B.	Auxiliary Units		
1	HYDROGEN GENERATION	KTPA	105*2
2	SULFUR BLOCK	TPD	245*2
3	SWS-I	TPH	193
4	SWS-II	TPH	293
5	ARU	TPH	388
6	SR LPG TREATER	TPA	135000
7	CRACKED LPG TREATER	TPA	140000
8	FG ATU	MMTPA	0.35
C.	EXISTING UNITS REQUIRING REVAMP		
1.	ISOM (existing capacity= 0.229 MMTPA)	MMTPA	0.069

2.	CCR (existing capacity = 0.769 MMTPA)	MMTPA	0.032
3.	DHDS (existing capacity = 2.43 MMTPA)	MMTPA	0
4.	DHDT (existing capacity = 2.2 MMTPA)	MMTPA	0

1.10 New Utility Systems

Following new Utility systems shall be augmented under VRMP for selected case.

Table-1.10: New Utility Systems

UTILITY SYSTEM	DESCRIPTION
Raw Water System	
Raw Water Treatment Plant	Treatment Plant of 1150 m3/hr capacity
Treated raw water Pumps	4+2 pumps of 320 m3/hr each
Recirculating Sea Cooling Water System	
Cooling Tower Cells	(4+1) cells each of 3500 m3/hr & (6+1) cells each of 3500 m3/hr
Recirculating Cooling Water Pumps	(4+1) pumps each of 3500 m3/hr & (6+1) pumps each of 3500 m3/hr
Bearing Cooling Water System	
Bearing Cooling Tower Cells	(5+1) cells each of 800 m3/hr
Bearing Cooling Water Pumps	(5+1) pumps each of 800 m3/hr
Demineralised Water System	
RO System	650 m3/hr

UTILITY SYSTEM	DESCRIPTION
DM Water Tanks	2 of 6500 m3 nominal capacity
DM Water Transfer Pumps	(2 + 2) pumps each of 250 m3/hr
Steam, Power and Boiler Feed Water System	
GTGs (frame VI)	1 numbers of 33 MW
HRSGs (VHP steam @ 36 kg/cm2g & 360 °C)	1 numbers of 100 TPH
STGs (Extraction type)	Two numbers, each of 32 MW design capacity & One numbers of 18 MW design capacity
Condensate System	
Condensate Polishing Unit	(1+1) chains of 45 m3/hr each
Compressed Air System (Plant and Instrument Air)	
Air Compressors	(2+1) air compressors of 5400Nm3/hr each
Instrument Air Dryer	2 Dual Bed Dryers of 3900 Nm3/hr each
Emergency Air Compressor	One HP Air compressor of 250 NM3/hr capacity
LP Air Receiver	One LP Air Receiver of Diameter =2.5m and H=6.2 m
HP Air Receiver	One HP Air Receiver of Diameter =4.9m and H=12.1 m
Nitrogen System	
Nitrogen Plant	1350 Nm3/hr (gaseous) 2*620 m3 liquid N2 tank

1.11 New Off site Facilities

The offsite facilities shall be augmented by adding the following new storage tanks and pumps in Refinery, ATP and COT/POT Area.

Table 1.11 : List of new crude tanks

Sl. No.	Service	No. of Tanks	Type	Liquid Stored Capacity (m3)
1	Sweet Crude	2	Floating	60000
2.	Sour Crude	4	Floating	60000
3.	Spare Tank for m/c	1	Floating	60000
4	Crude Water Drain Tank	1	Cone Roof	4606
5	Surge Relief tank	1	Cone Roof	553

Table 1.12 : List of new intermediate tanks for case 2A

Sl. No.	Service	No. of Tanks	Type	Liquid Stored Capacity (m3)
1	HCU Feed Tanks	2	Cone Roof with N2 blanketing	20000
2	Alkylate	2	Floating Roof	8170
3	Flushing Oil	2	Floating Roof	6629

Table 1.13 : List of new product tanks for Case 2A

Sl. No.	Service	No. of Tanks	Type	Liquid Stored Capacity (m3)
1	LPG	2	Mounded Bullets	2870
2	Propylene	3	Mounded Bullets	2870
3	Euro-V Diesel	2+2+1	Floating Roof	40000 & 46100 & 23529
4	Euro-IV Diesel	4	Floating Roof	40000
5	Euro-IV MS	1	Floating Roof	12549
6	Naphtha	1	Floating Roof	23529

Table 1.14 : List of new crude / product pumps for Case 2A

Sl. No.	Service	No. of pumps	Flow (m3/hr)	TYPE
1.	Crude Transfer pumps (VPT Area)	2+2	710	Centrifugal
2	Crude Transfer pumps (APT Area)	1+1	710	Centrifugal
3	HSD product Pump	1+1	1100	Centrifugal
4	MS product pump	1+1	850	Centrifugal
5	LPG	1+1	90	Centrifugal
6	Propylene	1+1	15	Centrifugal

Table 1.15 :List of new intermediate Pumps for Case 2A

Sl. No.	Service	No. of pumps	Flow (m3/hr)	TYPE
1.	SDA Feed pump	1+1	325	Centrifugal
2	HCU feed pump	1+1	415	Centrifugal
3	SHC feed pump	1+1	370	Centrifugal

4	Alkylate pump	1+1	40	Centrifugal
5	Flushing oil pump	2+1	100	Centrifugal

Note: All pumps are motor driven, CS MOC

1.12 Energy Conservation Efforts

Many state-of-art energy conservation measures outlined in section-13 are being incorporated at the design stage itself in order to minimize the overall energy requirement.

Environmental Impact

In order to minimize the impact of the project on the environment, due attention is being given for implementing effective pollution control measures. The design stage endeavors to mitigate the problems related to health, safety and environment at the process technology/source level itself. The design basis for all process units lays special emphasis on measures to minimize the effluent generation at source.

Liquid effluents

The liquid effluents from Refinery post VRMP will meet the Minimum National Standards as specified under proposed effluent and emission standards for petroleum oil refineries by suitable augmentation of Effluent Treatment Plants. Furthermore in the effort to minimize the effluent generation, system like recirculating cooling water is being considered for the expansion. Also suitable provisions are made to enable maximum recycle and reuse of treated effluent.

Gaseous Emissions

All the emission from the Refinery Complex shall meet the stipulated standards under “PROPOSED EFFLUENT AND EMISSION STANDARDS FOR PETROLEUM OIL REFINERIES”.

- The total Sulphur Dioxide emissions from the refinery complex after development of proposed additional units and capacity expansion will not exceed the present limit of 11.5 T/day.
- New Sulfur Recovery Units has been considered with TGT facilities
- Sweet Refinery fuel gas with H₂S=100 ppmw (max.) has been considered.
- Low sulfur naphtha has been considered in GTGs.
- Low sulphur Fuel oil has been considered for firing in the furnaces.
- Heaters/furnaces will be provided with well-proven Low NO_x burners to restrict the emissions of Nitrogen Oxides (NO_x) to meet the proposed emission standards for Petroleum Oil refineries.

From the above it is evident that there will be no additional impact of gaseous emissions on the environment due to expansion.

Solid Wastes

The solid wastes i.e. Spent Catalysts, ETP Sludge, General Solid Wastes, Tank Bottom Sludge etc. generated in the Refinery shall be minimised by implementing solid waste management plan.

1.13 Social Benefits

The Visakh Refinery Modernization Project in addition to increasing the availability of petroleum products in the region is also expected to generate employment, both direct and indirect.